

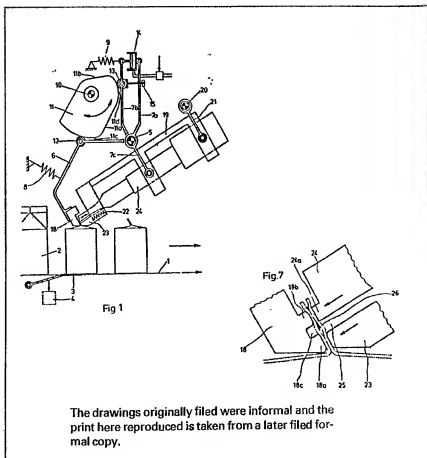
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(54) Apparatus for folding and sealing the top of a carton

(57) A fin seal on the top of a carton coated internally with thermoplastic material is provided at a combined folding and pressure welding station. A conveyor (1) conveys cartons in an upright position to said station. The folding and pressure welding tools include a pair of jaws (18, 23) movable together and apart. Jaw (18) comprises a folding and clamping part (18a) and an anvil (18b) located thereabove. The other jaw (23) has a folding and clamping part and together with an ultrasonic vibration generator (24), cooperable with the anvil (18b), is attached to a support (19).



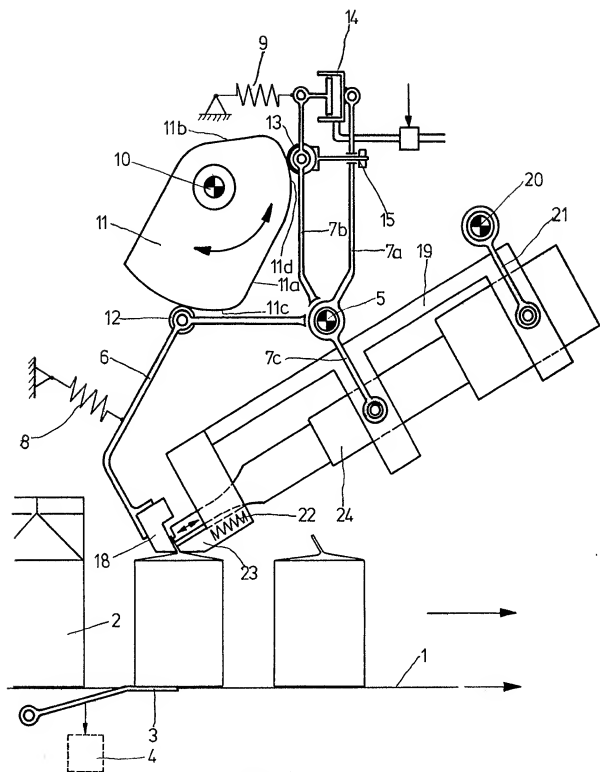


Fig. 1

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Fig. 2

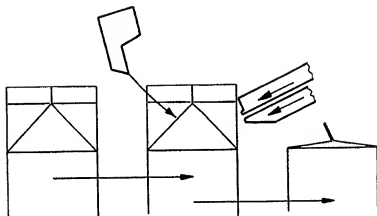


Fig. 3

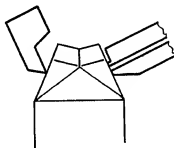


Fig. 4

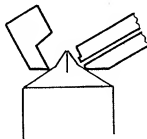


Fig. 5



Fig.6

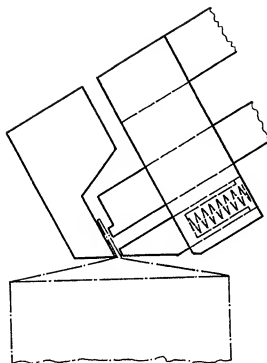
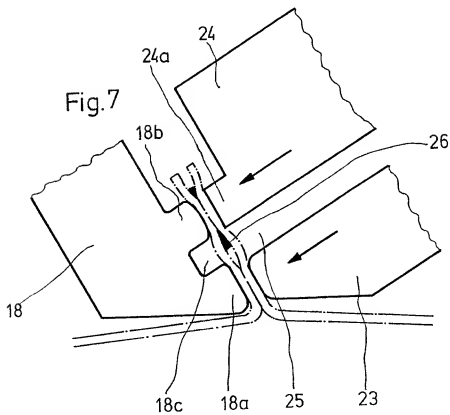
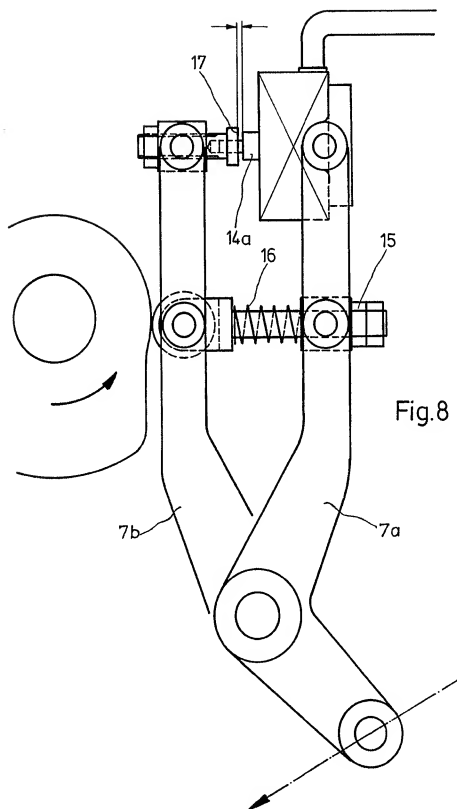


Fig.7





## SPECIFICATION

**Apparatus for folding and sealing the top of a folding box.**

The invention relates to an apparatus for folding and sealing the top of a folding box, which is pre-manufactured from a cardboard blank coated on its inside with a layer of thermoplastic synthetic material, in particular with a composite construction of a layer of thermoplastic synthetic material/aluminium foil/a layer of thermoplastic synthetic material, with a folding station, a pressure welding station operating with ultra-sound waves and conveying means conveying the folding boxes in sequence in an upright position to the folding station and pressure welding station.

In a known apparatus of this type, the top of each folding box is folded in a first station such that the web seam points in the conveying direction. The folding box then leaves this folding station and arrives at the actual pressure welding station. On the way to the latter, the folded top is retained in this condition by guide rails engaging the web seam from the side. The tools constructed as an anvil and sonotrode for heating the internal coating consisting of thermoplastic synthetic material simultaneously serve to press together the areas of the web seam to be welded to each other during the sealing operation and then to hold the latter together for a certain cooling period. For this reason, both the anvil as well as the sonotrode have flat pressing surfaces.

The object of the invention is to provide an apparatus of the afore-mentioned type, with which the folding and sealing operation of the top of the folding box can be carried out in a relatively short period of time and with a low expenditure as regards equipment.

This object is fulfilled according to the invention due to the fact that the folding station and pressure welding station are combined as one station, the folding tools and pressure welding tools consisting of a pair of jaws or tip able to move towards each other in the manner of tongs, whereof one jaw comprises a folding wedge and above the folding wedge an anvil and the other jaw is constructed as a folding and clamping wedge and together with a vibration generator for ultra-sound waves co-operating with the anvil is attached to a common support.

In the apparatus according to the invention, folding of the top and heating as well as pressure welding of the web takes place at a single station. In contrast to the known station, only one drive operating in the manner of tongs is required. This means not only a saving as regards equipment, but also a saving in the processing time of the folding box, since the tong-like movement which was previously necessary twice, once for the folding operation and once for the clamping and pressure welding operation, in this case needs only be carried out once. A further essential advantage consists in that the previously required intermediate conveyance

station is dispensed with, during which the web seam was held together by the guide rails. The abolition of this conveyance is essential insofar that it allows transverse conveyance of the boxes, i.e. at right-angles to the longitudinal side and thus also at right-angles to the web seam. The transverse conveyance of folding boxes is desirable because when using folding boxes with a rectangular cross section, which allows an optimum ratio of consumption of material and volume, it allows more rapid conveyance than longitudinal conveyance, without the filling material splashing too high. Finally, the combination of anvil and vibration generator on one side and additional clamping tools provides the advantage that despite the use of the ultra-sound welding method, faults in the form of craters are not formed in the welded seam. Now it was found that for reasons not described here, faults in the form of craters formed particularly when using a cardboard blank with an inner coating of a composite nature.

According to one embodiment of the invention, a cam disc is provided for actuating the jaws or their support, on which disc the jaws or their support bear. The cam disc preferably comprises a steep sloping cam section for the folding operation and a flat sloping cam section for the pressing operation. The varying conditions during the folding and pressing operation are taken into account with this varying slope. For the folding operation, a large movement is required with low forces and for the pressing operation, a small movement is required with high forces. One solution for the drive which is particularly favourable as regards construction consists in that the cam sections for both jaws or support are formed on the same cam disc driven in an oscillatory manner.

In order to be able to press together the areas of the web seam to be welded to each other, before heating the layer of thermoplastic synthetic material, without the vibration generator having to be switched-on at full compressive load, it is provided according to a further embodiment of the invention that a compression spring is located between a cam follower bearing on the cam sections and the support for the vibration generator, to which a stop coming into action solely after overcoming the spring force brings about the frictional connection.

It has been found that for a troublesome welded seam, the pressure acting on the vibration generator is important. In order to keep the pressure constant even in the case of the simple drive of the jaws by means of cam sections, a cylinder/piston arrangement which is under constant pressure can be provided as a pressure pad between the support for the vibration generator and the control cam. In order to provide the thermoplastic material compressed during the welding operation with the possibility for deflection, it is recommended that the anvil and vibration generator are located at a slight distance from the compression area of the clamping tools. A V-seam facing the inside of the box has proved particularly suitable as regards mechanical strength.

further feature of the invention, the latter can be produced if the anvil comprises a rib of curved cross section extending in the direction of the web seam, which rib serves as a stop face for the vibration generator.

Since, as afore-mentioned, it is important to maintain a certain pressure for a troublefree web seam, certain recesses may be provided in the anvil, for example in order to receive thicker portions of the individual sections of web seam. For example, if the longitudinal seam of the folding box intersects the web seam, a recess can be provided in the anvil for receiving the section of web seam which is thickened by the longitudinal seam, the size of the recess corresponding to the oversize of the section of web seam.

The invention is described in detail hereafter with reference to the drawings illustrating one embodiment:

Figure 1 shows an apparatus for folding and sealing the top of a folding box in side view,

Figure 2 shows the folding and pressure welding tools directly before the folding operation,

Figures 3 and 4 show the folding and pressure welding tools during the folding operation,

Figure 5 shows the folding and pressure welding tools during the pressing and welding operation,

Figure 6 shows the object according to figure 5 to an enlarged scale,

Figure 7 shows the object according to figure 6 after the welding operation, to an enlarged scale,

Figure 8 shows an actuating arm for the welding tool constructed as a vibration generator, on an enlarged scale with respect to figure 1.

By means of a conveyor belt 1, the pre-manufactured folding boxes 2 filled with liquid and comprising a top which is not yet closed, are supplied in sequence and in an upright manner and with the areas of the web seam to be welded extending at right-angles to the conveying direction, to the combined folding and pressure welding station. The boxes are conveyed gradually. The presence of a folding box below the station is ascertained by a feeler 3, which by means of a control device 4 causes starting-up of the pressure welding station operating with ultra-sound waves.

The actuating mechanism of the combined folding and pressure welding station consists essentially of two lever arms 6, 7a, 7b mounted to pivot at a common fixed point 5 of the machine frame (not shown). The lever arms 6, 7b are pressed by means of springs 8, 9 against a cam disc 11 driven in an oscillatory manner about a fixed point 10, in which case the lever arms are supported on the periphery of the cam disc 11 by way of followers 12, 13 constructed as rollers. The cam disc 11 is thus constructed such that it comprises for each lever arm 6, 7b a steep cam section 11a, 11b and a flat cam section 11d, 11c.

The lever arm 7a, 7b is constructed in two parts. In the simplest case (figure 1), the free ends of the two parts 7a, 7b are interconnected by way of a pressure pad in the form of a cylinder/piston arrangement 14 which is under constant pressure. The maximum space between the two parts 7a, 7b

is limited by a stop 15. In the embodiment of figure 8, the two parts 7a, 7b are additionally spread apart by the spring 16. Provided that the station is not brought into the operating position, the part 7a bears against the stop 15. In this position, there is an air gap between the plunger 14a of the piston and of the cylinder/piston arrangement 14 and an adjustable stop 17 on the part 7b.

The free end of the lever arm 6 supports a jaw 18, which comprises a folding wedge 18a in the lower region and in the upper region an anvil 18b with a surface of slightly curved cross section. A groove 18c is provided between the folding wedge 18a and anvil 18b. The folding wedge 18a simultaneously serves as a clamping tool.

Whereas the lever arm 6 is constructed with one arm, the part 7a is constructed with two arms. A support 19 for the folding and pressure welding tool is attached to the free arm 7c and to a hinged arm 21 arranged in parallel thereto and mounted at a fixed point 20 of the machine frame, in the manner of a parallel guide arrangement. A jaw 23 cooperating with the folding wedge 18a is mounted on a spring 22 supported in the support 19. Like the folding wedge 18a, the jaw 23 simultaneously serves as a clamping tool. Also held in the support 19 is a vibration generator 24, which can carry out oscillations at a frequency of approximately 20KHz in the direction of the arrows shown. In the operating position, a gap 25 provided between the folding and clamping tool 23 and a tip 24a of the vibration generation 24 is located opposite the groove 18c.

The afore-described apparatus operates in the following manner:

Normally, the individual folding boxes 2 are supplied by means of a conveyor belt 1 in close succession, but gradually, to the processing station. As soon as the full container, which is open at the top, arrives under the processing station, the movements of the folding and pressing tools are initiated by the cam disc 11. Then, first of all, the steep cam sections 11a, 11b come into action, so that large movements are carried out with relatively low forces. Since these forces are less than the force of the spring 16, the parts 7a, 7b of the lever arm remain spread apart. This folding operation is illustrated in figures 2 to 5, figure 5 simultaneously illustrating the final position of the folding operation and the position for the pressing and welding operation. The folding wedges 18a, 23 are arranged such that the web seam is slightly inclined at the end of the folding operation, in order to be able to carry out the subsequent tilting more easily. As soon as the folding and pressure welding tools meet after the completion of the folding operation (figure 5), the flatter cam sections 11c, 11d come into action. From this point on, the necessary higher pressing force can be applied. Thus, the force of the spring 16 is overcome and after overcoming the dead space between the plunger 14a and the adjustable stop 17, the pressure welding tool with the tip 24a presses with an increased force against the web seam. The time which is taken to overcome the dead space is used for starting up the vibration generator. This instant is favourable, because on

the one hand the areas of the web seam to be welded to each other are already held firmly together, but on the other hand the pressing force of the vibration generator is not yet so great that it makes starting up of the vibration generator difficult. When the dead space has been overcome, irrespective of the tolerances of thickness of the web seam, the web seam is acted upon at a constant pressure, since the interposed cylinder/piston arrangement 14 which is under constant pressure equalizes tolerances of thickness.

Figure 7 shows that the thermoplastic material softened by ultrasound on the inner sides of the web seam is compressed towards the edges. On account of the curved surface of the anvil 18b, the pressure towards the inside of the box decreases continuously. Therefore, with the formation of a V-seam 26, the compressed thermoplastic synthetic material is able to flow in the area of the web seam, where the groove 18c and the gap 25 allow areas of the web seam to curve outwards. Since, during the sealing operation, the purpose of the anvil 18b and the tip 24a of the vibration generator is solely to soften the thermoplastic material, whereas the purpose of holding the areas of the web seam together is undertaken by the combined folding and clamping tools 18a, 23, a troublefree, i.e. crater-free welded seam is produced.

The main advantage of the invention consists in that it provides the possibility of transverse conveyance of folding boxes having a rectangular shape on their base and the complete sealing of the top at a single station.

#### CLAIMS

1. Apparatus for folding and sealing the top of a folding box fabricated with an internal coating of thermoplastic synthetic material, preferably a composite layer of thermoplastic synthetic material/aluminium foil/a layer of thermoplastic synthetic material comprising a folding station, a pressure welding station operating with ultra-sound waves and conveying means for conveying the folding box in an upright position to the folding station and pressure welding station, wherein the folding station and pressure welding station are combined into a single station, the folding tools and pressure welding tools comprising a pair of jaws movable together and apart, whereof one jaw comprises a folding wedge and an anvil thereabove and the other jaw is constructed as a folding and clamping wedge and together with a vibration generator for ultra-sound waves cooperating with the anvil is attached to a common support.

2. Apparatus as claimed in claim 1, wherein for the purpose of their actuation, the jaw or the support bear on cam sections.

3. Apparatus as claimed in claim 2, wherein the control cam comprises a steep sloping cam section for the folding operation and a flat sloping cam section for the pressing operation.

4. Apparatus as claimed in claim 2 or 3, wherein the cam sections for the jaw or the support are formed on the same cam disc which is driven in an

5. Apparatus as claimed in any one of claims 2 to 4, wherein located between a cam follower bearing on the cam sections and the support for the vibration generator is a compression spring, to which a stop solely coming into action after overcoming the force of the spring brings about the frictional connection.

6. Apparatus according to any one of claims 2 to 5, wherein a cylinder and piston arrangement which is under constant pressure is provided as a pressure pad between the support for the vibration generator and the cam sections.

7. Apparatus according to any one of claims 1 to 6, wherein the anvil and the vibration generator are located at a slight distance from the compression region of the clamping tools.

8. Apparatus according to any one of claims 1 to 7, wherein the anvil comprises a rib of curved cross section extending in the direction of the web seam and serving as a stop face for the vibration generator.

9. Apparatus according to any one of claims 1 to 8, wherein provided in the anvil is at least one recess for receiving a thickened section of web seam the size of the recess corresponding to the oversize of the thickened section of web seam.

10. Apparatus for folding and sealing the top of a folding box, substantially as herein described with reference to and as illustrated in the accompanying drawings.